Barge unloading system

Patent number: GB2087335
Publication date: 1982-05-26
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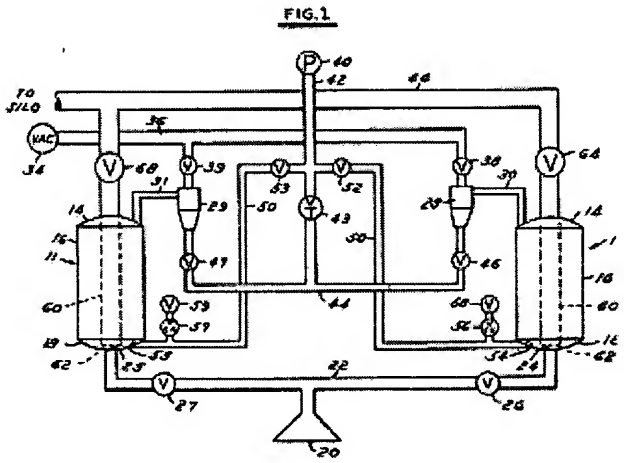
Classification:
- international: B65G53/28
- european: B65G53/28
Application number: GB19810029557 19810930
Priority number(s): US19800205805 19801110

Also published as:
JP57093829 (A)
DE3141065 (A1)
IT1144780 (B)

Abstract of **GB2087335**

A system and method for unloading dry, bulk, particulate material from a ship, barge or the like through a nozzle 20 alternately into first and second pressure vessels 10 and 11 and thereafter alternately transferring material from the pressure vessels into a storage container such as a silo. As one pressure vessel 10 is being filled, the material from the other pressure vessel 11 is being transferred into the silo. Thus the filling and emptying of the first pressure vessel 10 is 180 degrees out of phase relative to the filling and emptying of the second pressure vessel 11. Suction is used to draw the dry, bulk, particulate material from the ship into the pressure vessel. Thereafter, air is forced through the pressure vessel to transfer the material from the pressure vessel to the silo. Each pressure vessel is both filled and emptied from the bottom. The pressure vessels are physically close to the nozzle, resulting in a shorter, more efficient suction path, and the pressure vessels and nozzle are portable and may be lowered into the hold of a ship, barge or the like.



(12)UK Patent Application (19)GB (11) 2 087 335 A

(21) Application No 8129557
(22) Date of filing
30 Sep 1981
(30) Priority data
(31) 205805
(32) 10 Nov 1980
(33) United States of America (US)
(43) Application published
26 May 1982
(51) INT CL³ B65G 53/28
(52) Domestic classification
B8A 3AF
(56) Documents cited
GB 2054502A
GB 1371375
US 4085975A
US 3373883A
(58) Field of search
B8A
(71) Applicants
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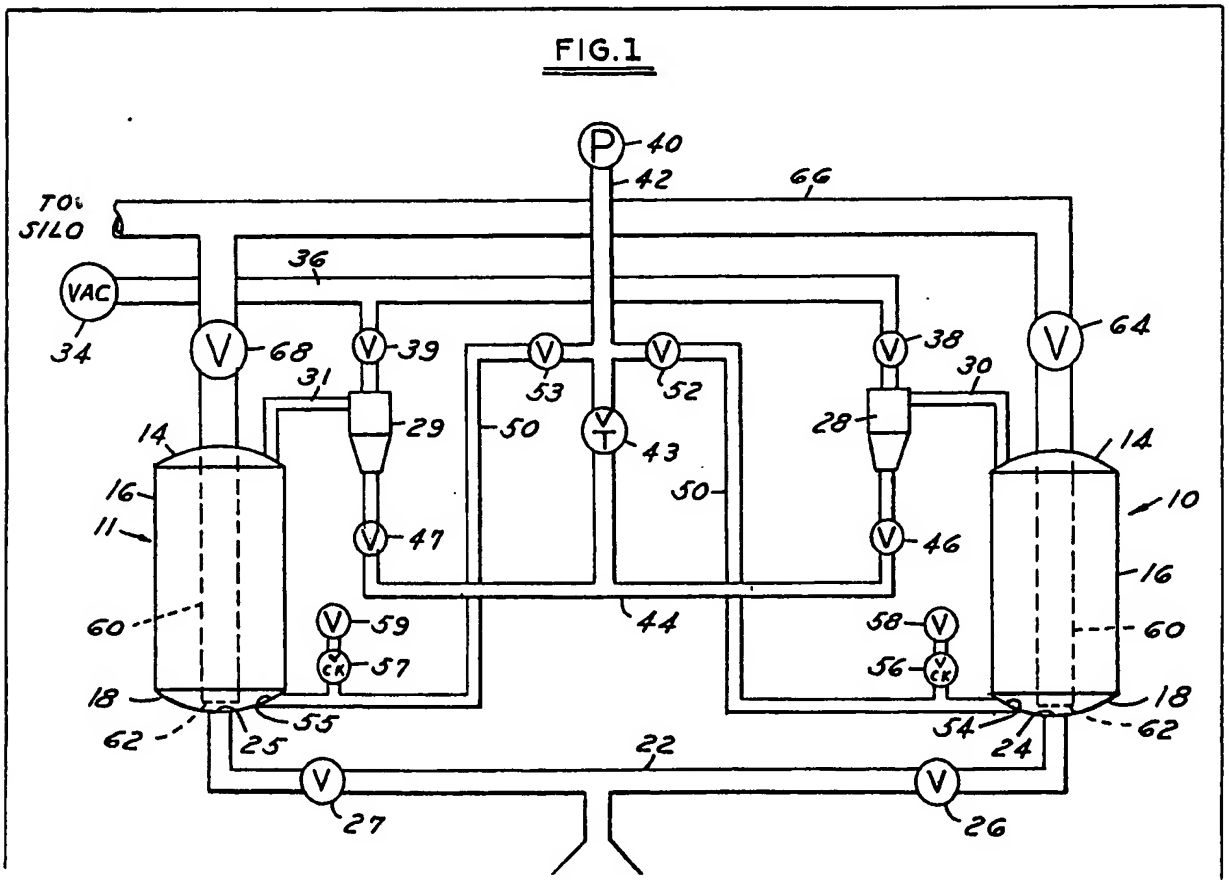
(54) Barge unloading system

(57) A system and method for unloading dry, bulk, particulate material from a ship, barge or the like through a nozzle 20 alternately into first and second pressure vessels 10 and 11 and thereafter alternately transferring material from the pressure vessels into a storage container such as a silo. As one pressure vessel 10 is being filled, the material from the other pressure vessel 11 is being transferred into the silo. Thus the filling and emptying of the first pressure vessel 10 is 180 degrees out of phase relative to the filling and emptying of the second pressure vessel 11. Suction is used to draw the dry, bulk, particulate material from the ship into the pressure vessel. Thereafter, air is forced through the pressure vessel to transfer the material from the pressure vessel to the silo. Each pressure vessel is both filled and emptied from the bottom. The pressure vessels are physically close to the nozzle, resulting in a shorter, more efficient suction path, and the pressure vessels and nozzle are portable and may be lowered into the hold of a ship, barge or the like.

FIG.1



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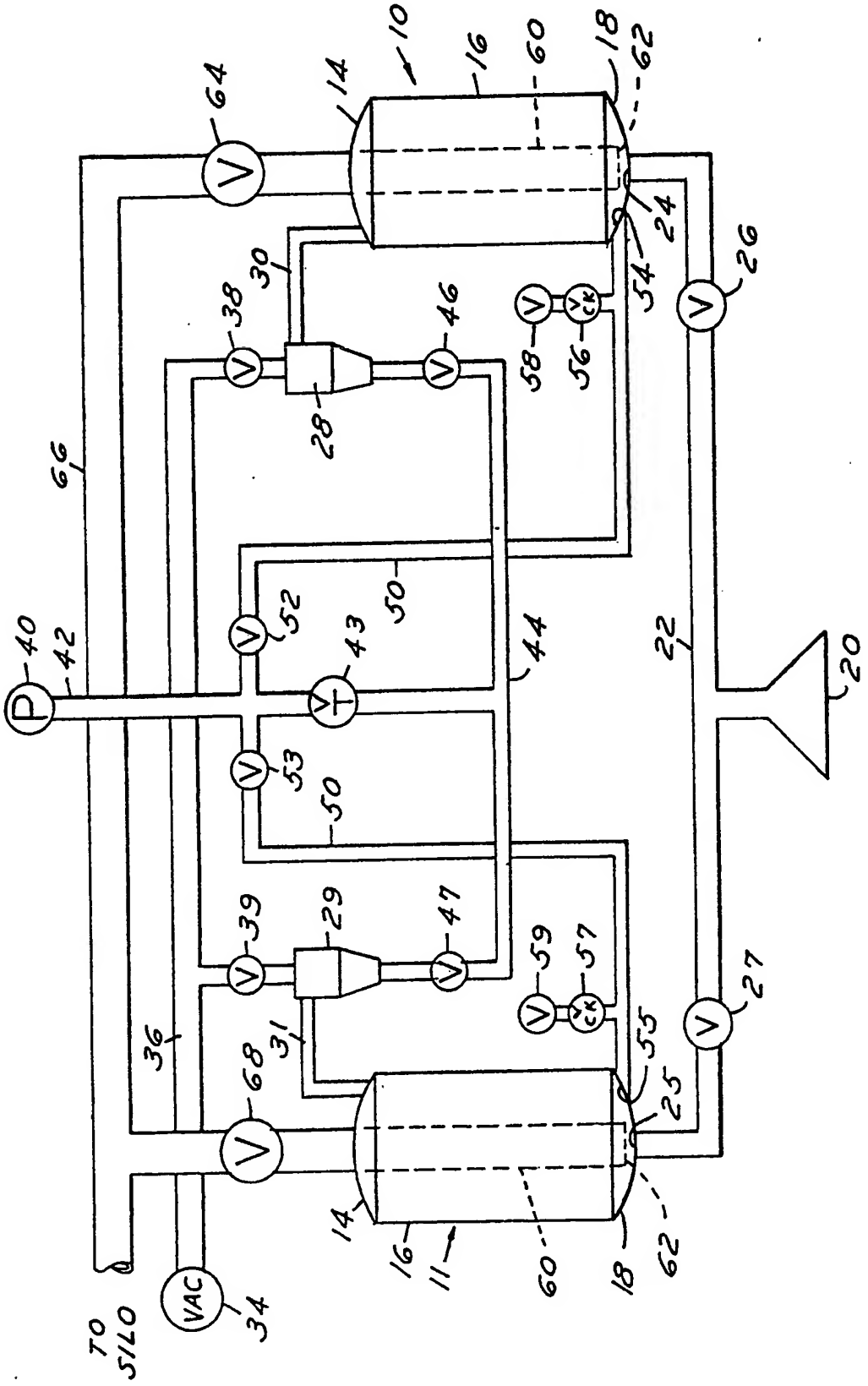

FIG.1

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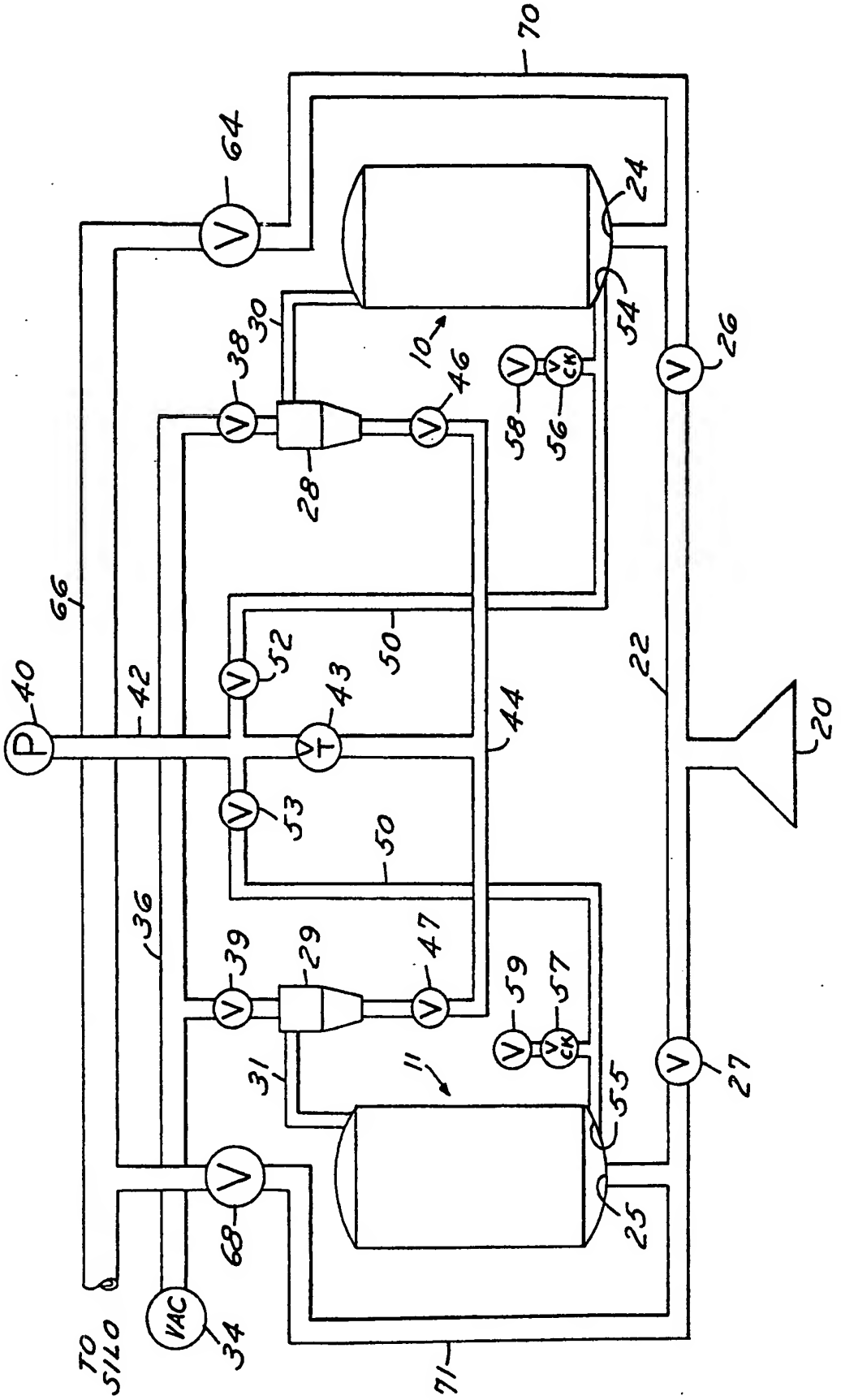
FIG.2



SPECIFICATION

Barge unloading system

TECHNICAL FIELD OF THE INVENTION

The invention relates to a barge unloading system and, more specifically, to an improvement in a system for unloading dry, bulk, particulate material from a barge, ship or other container into an intermediate holding container or pressure vessel, commonly called a reloader, and thereafter transferring the material from the reloader into a storage container such as the silo.

BACKGROUND ART

It is known to unload a barge by a vacuum or suction technique where the dry, bulk, particulate material such as cement powder, grain, fertilizer or the like is transferred by vacuum or suction from the barge into a reloader and thereafter transferred, under pressure, into a more permanent storage container such as a silo. A system of this type is disclosed in United States Patent No. 3,373,883, where a plurality of reloaders may be used and while the first reloader is being filled with material from the barge, the second reloader is being emptied by transferring the particulate material from the second reloader into a silo. This is referred to as a push-pull system because some particulate material is being pushed, by air, from the second reloader into the silo while additional particulate material is being pulled, by vacuum or suction, from the barge into the first reloader.

In the use of such a system, it takes approximately three times as long to empty the reloader as it takes to fill the reloader. Thus, prior systems of the kind described in United States Patent No. 3,373,883 result in a situation where the filling of one reloader is completed prior to completion of the emptying of the other reloader, thus providing a reduction in efficiency. The optimum efficiency would be to increase the rate of emptying the reloader so that the filling of one reloader will be accomplished in essentially the same time as the emptying of the other reloader.

In United States Patent 4,085,975, a system is described for increasing the efficiency of a push-pull system by aerating the particulate material as the reloader is being filled. Thus, the subsequent emptying of the reloader may be accomplished more quickly because the aerated particulate material flows more rapidly than non-aertaed particulate material.

DISCLOSURE OF THE INVENTION

It is an object of the invention to seek to

According to one aspect of the invention there is provided a method for unloading dry, bulk, particulate material from a ship, barge or the like through a nozzle and a suction path into first and second pressure vessels and for thereafter transferring the material from the pressure vessels to a storage container or silo, the steps of filling a pressure vessel and transferring material from said pressure vessel being repeated in alternating sequence, comprising the steps of:

creating suction through a first pressure vessel to fill the first pressure vessel by drawing dry, bulk, particulate material into said pressure vessel through the bottom thereof;

simultaneously forcing air into said second pressure vessel to empty the contents of said second pressure vessel for transferring the contents to a silo or the like; and

thereafter creating suction through said second pressure vessel to fill said second pressure vessel by drawing dry, bulk, particulate material into said second pressure vessel through the bottom thereof while simultaneously forcing air through said first pressure vessel to empty the contents of said first pressure vessel for transferring the contents to said silo.

According to a second aspect of the invention there is provided a system for unloading dry, bulk, particulate material from a ship, barge or the like through a nozzle and a suction path into first and second pressure vessels and for thereafter transferring the material from each of said pressure vessels into a storage container or silo, comprising a vacuum means and a source of compressed air, said vacuum means being for inducing a suction through said pressure vessels in alternating sequence and through said suction path to said nozzle and said compressor being for pressurizing each of said pressure vessels in alternating sequence, a suction being created in one of said pressure vessels while the other said pressure vessel is being pressurized, and a bottom inlet port for each pressure vessel for filling each pressure vessel from the bottom.

Thus, the invention is directed to an improved unloading system and method for transferring dry, bulk, particulate material from a ship barge or the like into a temporary pressure vessel such as a reloader and thereafter transferring the material to a storage container or silo. Two reloaders maybe provided with each reloader being initially filled with particulate material from the barge and thereafter emptied by transferring the material to the silo. The two reloaders are operated 180 degrees out of phase in that one reloader is being filled while the other reloader is being emptied.

The efficiency of a reloader may be substan-

under the influence of the vacuum or suction. Accordingly, a system embodying the invention may provide portable reloaders which may be physically placed over the hold of a ship, barge or the like with a short suction line from the reloader to a nozzle which is inserted in the dry, bulk, particulate material. This is to be distinguished from prior art devices which were primarily maintained on shore, even though movable by a crane or the like, with a long suction line from the reloader to the nozzle.

Furthermore, a system, and method embodying the invention may provide a novel arrangement for both filling and emptying the reloader thus increasing the system efficiency. Thus the present system, by filling the reloader from the bottom (i.e. a bottom inlet port) is contrary to the prior art (for example U.S. Patent No. 4,085,975) and also disregards the benefit which would be obtained by the influence of gravity if an above-bottom inlet port was used. None-the-less, the present system provides a surprising efficiency.

The following comparison demonstrates the surprising efficiency of a invention embodying the invention. Consider a prior art system as described in United States Patent No. 3,373,883. Such a system has a nominal transfer rate (ship or barge to silo) of 200 tons per hour. A vacuum pump would provide a suction pressure of about 22 inches and this requires a 300 horsepower pump if a barge was being unloaded. An ocean going ship, because of the deeper cargo holds, would require about an 800 horsepower pump. Each reloader has a capacity of 30 tons, filling time is about 3 minutes per reloader and discharge time for a reloader is about 9 minutes. Thus about 25% of a complete cycle (i.e., a cycle meaning the total length of time to first fill and then empty a reloader) was used for filling the reloader and about 75% of the cycle was used to empty a reloader.

A system embodying the invention has a similar nominal transfer rate of 200 tons per hour. However, since the reloaders are to be lowered into the barge or ship the reloaders are smaller, each having a capacity of about 1.3 tons. Since the reloaders are adjacent the nozzle a short suction line may be used thus only a 60 horsepower vacuum pump is needed to provide about 11 inches of suction pressure. Each reloader is filled in about 21 seconds and emptied in about 21 to 24 seconds. The present invention thus provides the surprising result that only about 50 to 53 percent of the cycle time is devoted to unloading the reloader with no sacrifice in overall capacity or transfer rate.

Thus, it may be appreciated that by the present invention, much smaller equipment (reloaders and vacuum pump) are required to

appreciated that many factors such as amount of aeration, delay in emptying causing compacting of the cement, etc., will change the figures. Hence, all the above figures are subject to variance but do accurately reflect actual operation under normal conditions and thus present a fair comparison.

Systems embodying the invention are hereinafter described, by way of example, in the accompanying drawings.

In the drawings, wherein like reference numerals identify corresponding components:

Figure 1 is a diagrammatic illustration of a system and method embodying the invention; and

Figure 2 is a diagrammatic illustration of a modification of the system and method of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

With reference to Fig. 1, a system is illustrated according to the principles of the present invention including a first pressure vessel or reloader 10 and a second pressure vessel or reloader 11 each of which is to be filled with cement powder or other dry, bulk, particulate material from a barge, ship or the like. Each pressure vessel 10, 11 is a generally cylindrical container having a domed top 14, a generally vertical side wall 16 and a conical or domed bottom 18, with the reloaders 10, 11 each being generally circular in plan view.

Means are provided for filling each reloader with dry, bulk, particulate material from a ship, barge or the like. Specifically, a single nozzle 20 is provided and is to be inserted into the dry, bulk, particulate material. One end of the nozzle is open for insertion into the particulate material and the other end of the nozzle is connected intermediate the ends of a first short conduit 22. One end of conduit 22 enters the bottom of pressure vessel 10 at an inlet port 24 and the other end of conduit 22 enters the bottom of the pressure vessel 11 at an inlet port 25. The conduit 22 is provided with two valves 26, 27 with valve 26 being intermediate the nozzle and the pressure vessel 10 and valve 27 being intermediate the nozzle and the pressure vessel 11. Since the conduit 22 enters the bottom of each pressure vessel, it may be appreciated that each pressure vessel is filled from the bottom. The nozzle preferably includes rotating mechanical aerators such as the type disclosed in United States Patent No. 4,140,350.

The present system includes a pair of conventional cyclone dust separators 28, 29. The cyclone dust separator 28 has an upper inlet port connected by a conduit 30 to the top of the pressure vessel 10 and cyclone dust separator 29 has an upper inlet port connected by a conduit 31 to the top of pressure vessel

the junction of the vertical side walls 16 and domed top 14.

Part of the means for filling each pressure vessel 10, 11 includes a vacuum pump 34 connected by a conduit 36 to the top of each cyclone separator. Specifically, conduit 36 is connected through a valve 38 to the top of cyclone separator 28 and is also connected through a valve 39 to the top of cyclone separator 29.

The means for emptying each pressure vessel 10, 11, will now be explained. A compressor or source of pressurized air 40 is connected to one end of a conduit 42. The other end of conduit 42 is connected intermediate the ends of a conduit 44. A throttle valve 43 is positioned in conduit 42. One end of conduit 44 is connected through a valve 46 to the bottom port of the cyclone dust separator 28 and the other end of the conduit 44 is connected through a valve 47 to the bottom port of cyclone dust separator 29.

Compressor 40 thus provides pressurized air to the bottom of each cyclone dust separator. In addition, the compressor 40 also provides pressurized air to the bottom of each pressure vessel. Specifically, a conduit 50 intersects conduit 42 between the compressor 40 and the throttle valve 43. Conduit 50 has a first valve 52 adjacent the intersection of conduits 42 and 50 and conduit 50 thereafter extends to an inlet port 54 adjacent the bottom of the pressure vessel 10. Conduit 50 is also provided with a second valve 53 adjacent the intersection of conduit 50 and 42 and the opposite end of conduit 50 is connected to an inlet port 55 adjacent the bottom of the pressure vessel 11. In this fashion, compressed air may be provided to the bottom of each pressure vessel 10, 11. An aeration pad such as that described in United States Patent No. 4,085,975 may be provided in the conical bottom of each pressure vessel 10, 11. An optional check valve 56 may be provided to permit ambient air to enter conduit 50 and thus enter the bottom of pressure vessel 10, and a valve 58 may be provided on the opposite side of the check valve 56 from the pressure vessel 10 so that closing the valve 58 by-passes the operation of the check valve 56. When valve 58 is open, check valve 56 operates to bleed air into the pressure vessel during the filling of the pressure vessel, to aerate the particulate material, as described in United States Patent No. 4,085,975.

A similar check valve 57 and valve 59 are provided at the opposite end of conduit 50 adjacent the pressure vessel 11 to permit aerating the particulate material during filling of the pressure vessel 11.

According to the principles of the present invention, within the pressure vessel 10 there 62 interiorly of the pressure vessel and substantially adjacent the lower conical bottom 18 of the pressure vessel 10. This elongated pipe or conduit 60 extends upwardly along substantially the entire interior length of the pressure vessel 10 and extends outwardly through the domed top 14 of pressure vessel 10 and thereafter to a valve 64. The opposite side of the valve 64 is coupled through conduit 66 to a silo or other permanent storage means for the particulate material. As is conventional, a high level detector is provided in the pressure vessel 10 to provide a signal when the level of the particulate material in the pressure vessel reaches the height of the detector.

Since pressure vessels 10 and 11 are identical, pressure vessel 11 also includes a hollow vertical pipe or conduit 60 interiorly of the pressure vessel 11 and extending substantially the entire length of the pressure vessel 11 and opening through the domed top 14 of the pressure vessel 11. The pipe 60 in pressure vessel 11 extends through a valve 68 to the conduit 66.

Now that the system and all its component parts have been described, the function and operation of the system will be explained in detail. Consider the situation when a pressure vessel 10 is empty and it is desired to fill the pressure vessel 10. Valves 26, 38, 47, 53 and 68 are opened and valves 27, 39, 46, 52 and 64 are closed. In addition, valve 58 is open if it is desired to aerate the dry bulk particulate material during the filling of the pressure vessel 10.

The vacuum pump 34 is turned on to create a suction in conduit 36. This creates a flow path from the nozzle 20 through the conduit 22 and valve 26 to the interior of the reloader and the flow path continues through the conduit 30 to the cyclone separator 28, through valve 38 end through the conduit 36. Operation of the vacuum pump 34 exhausts the air in this flow path which causes the dry bulk particulate material to flow through the nozzle 20, conduit 22 and valve 26 into the pressure vessel to fill the pressure vessel from the bottom inlet port 24. The particulate material flows as a fluidized medium and any air flowing with the dry bulk particulate material into the pressure vessel will continue through the conduit 30 and into the cyclone separator 28. It may be expected that some of the air will be laden with dust and particulate material and, as the dust laden or particulate laden air enters the cyclone separator 28, the dust and particulate matter settles to the bottom of the cyclone separator 28 thus cleansing the air. A filter may be provided as part of the vacuum pump 34 to further prevent any dust or particulate material from reaching the vacuum pump. The vacuum pump continues to

level indicator or detector within the pressure vessel 10 and the filling cycle of the pressure vessel 10 is now complete.

Simultaneously with filling the pressure vessel 10 it is possible to transfer the contents of the other pressure vessel, i.e., pressure vessel 11, to the silo. Specifically, with the valves heretofore open and closed remaining opened and closed, respectively, the compressor 40 is actuated to blow compressed air through the conduit 42. This compressed air through the conduit 42 flows through that portion of conduit 50 which extends between valve 53 and the inlet port 55 at the bottom of the pressure vessel 11. Since valve 27 is closed no particulate material enters the bottom of pressure vessel 11. Valve 43 is a manually controlled throttle valve which functions to adjust or divide the air flow into two paths, the first path being from the conduit 42 into the conduit 44 and the second path being from the conduit 42 into the conduit 50. Thus some of the air from compressor 40 flowing through the conduit 42 flows through the valve 53 and into the bottom of the pressure vessel. Throttle valve 43 also permits some of the compressed air to flow through conduit 44 and valve 47 and into the bottom of the cyclone separator 29 to empty the dust from the bottom of the cyclone separator through conduit 31 into the pressure vessel 11.

At this point it should be explained that according to the principles of the present invention, aeration may be accomplished during filling the pressure vessel, during emptying a pressure vessel or both. If it is desired to aerate only during emptying the reloader, valves 58 and 59 should always be closed. If it is desired to aerate only during filling a pressure vessel, valves 52 and 53 should always be closed and valves 58 and 59 should always be open. With valves 58 and 59 open, check valves 56 and 57 admit air into the respective pressure vessels only when the pressure from the pressure vessel is less than the ambient air pressure.

The air from the compressor 40 flows through the conduit 42 and a throttle valve 43 and into the bottom of the cyclone separator 29 as just explained. Even with the valve 53 open, the majority of the air flows through the throttle valve 43 and the valve 47 into the dust separator 29. The air flow through the dust separator 29 enters at the bottom of the dust separator, cleaning out any dust collected and blows all of such dust through conduit 31 and into the pressure vessel 11. The air flowing into the pressure vessel 11 thus pressurizes the pressure vessel 11 and forces the dry, bulk, particulate material down within the interior of the pressure vessel 11 into the open bottom 62 of the conduit 60, up through the conduit 60 along the entire length of the pressure vessel and through the

directly to the silo. The silo, of course, may be provided with dust collector bags as is conventional to remove any dust or particulate material from the air entering the silo before such air is discharged into the atmosphere.

At the conclusion of the cycle heretofore explained, with pressure vessel 10 full and pressure vessel 11 emtpy, the first one-half cycle is now completed. The next step is to fill the pressure vessel 11 and simultaneously empty pressure vessel 10. To accomplish this aspect of the present system, valves 26, 38, 47 and 68 are closed and valves 27, 39, 46 and 64 are now opened. In addition, valves 52 and 53 may be adjusted, as desired, depending on the choice with respect to aeration during filling and emptying as previously described. Upon the actuation of the valves as just described, a first flow path is created from the nozzle 20 through the conduit 22 and valve 27 and through the bottom inlet port 25 into the pressure vessel 11, thereafter through conduit 31, dust collector 29 and valve 39 into the conduit 36 and thence to the vacuum pump 34. This first flow path creates an induced suction so that the dry, bulk, particulate material enters the pressure vessel 11 until the level of the particulate material reaches the height of the level detector in pressure vessel 11. Simultaneously, the compressor 40 blows air through throttle valve 43 and valve 46 into the dust collector 28 thus cleaning out the dust collector 28 and blowing any dust collected therein through conduit 30 and into the pressure vessel 10 thus pressurizing the vessel 10 and forcing the dry, bulk, particulate material through the open bottom 62 of the pipe 60 and up through the pipe 60 and valve 64 into the conduit 66 and then to the silo.

As previously explained, efficiency of the present system is optimized by providing the shortest possible suction path for the particulate material to flow and, to accomplish these objectives, conduit 22 is made as short as possible since conduit 22 defines, for all practical purposes, the variable length of the suction path through which the dry, bulk, particulate material will flow. Thus the present invention contemplates placing the two pressure vessels 10 and 11 as close together as possible and as close to the nozzle 20 as possible thus achieving the objective of a very short suction path or conduit length 22. Furthermore, while placing the pressure vessels 10 and 11 as close together as possible, and as close as possible to the nozzle 20, the present system is portable in that the pressure vessels along with the cyclone separators and associated conduits may be lowered into the hold of a ship.

Reference should now be had to Fig. 2 where a modification of the system of the

of Fig. 1 primarily because the discharge conduits for emptying the pressure vessels extend exteriorly of the pressure vessels while retaining the advantage of discharging or unloading a pressure vessel from the bottom thereof. The essential difference between the apparatus and system of Fig. 1 and the apparatus and system of Fig. 2 is that in apparatus and system of Fig. 1, a pipe or conduit 60 is provided interiorly of each pressure vessel while in the apparatus, method and system illustrated in Fig. 2 a first conduit 70 is provided between the valve 26 and valve 64 exteriorly of the pressure vessel 10 and a second conduit 71 is provided between the valve 27 and the valve 68 exteriorly of pressure vessel 11. In all other respects, the apparatus, method and system described in Figs. 1 and 2 are identical.

Since the difference in operation between Figs. 1 and 2 involve only the emptying of the pressure vessel, the emptying of pressure vessel 10 will be described. In order to empty pressure vessel 10, the valves 27, 39, 46 and 64 are open and valves 26, 38, 47 and 68 are closed. Throttle valve 43 is adjusted as are the valves 52 and 53 and the valves 58 and 59 depending on the desired aeration during the filling and emptying as heretofore described. Air from the compressor 40 flows through the conduit 42 and conduit 44 and valve 46 into the bottom of the cyclone dust separator 28 and thereafter through conduit 30 into the pressure vessel 10 thus pressurizing the pressure vessel 10. Pressurizing the contents of pressure vessel 10 causes the dry, bulk, particulate material to flow outwardly through the bottom of the pressure vessel 10 and into conduit 70, through valve 64 and thence to the silo. Obviously, when the valve positions are reversed or changed from open to closed, for the purpose of filling pressure vessel 10 and emptying pressure vessel 11, the dry, bulk, particulate material flows from the pressure vessel 11 into the conduit 71 and through the valve 68 to the silo.

Thus, it may be appreciated, that in each of the embodiments of the present invention, the pressure vessels are both filled and emptied from the bottom of the respective pressure vessels.

CLAIMS

1. A method for unloading dry, bulk, particulate material from a ship, barge or the like through a nozzle and a suction path into first and second pressure vessels and for thereafter transferring the material from the pressure vessels to a storage container or silo, the steps of filling a pressure vessel and transferring material from said pressure vessel being repeated in alternating sequence, comprising

ing dry, bulk particulate material into said pressure vessel through the bottom thereof;

simultaneously forcing air into said second pressure vessel to empty the contents of said second pressure vessel for transferring the contents to a silo or the like; and

thereafter creating suction through said second pressure vessel to fill said second pressure vessel by drawing dry, bulk, particulate material into said second pressure vessel through the bottom thereof while simultaneously forcing air through said first pressure vessel to empty the contents of said first pressure vessel for transferring the contents to said silo.

2. A method according to claim 1, further including the steps of aerating the dry, bulk, particulate material while filling a pressure vessel.

3. A method according to claim 1 or Claim 2, and further including aerating the dry, bulk, particulate material while transferring the contents of a pressure vessel to a silo or the like.

4. A method according to any preceding claim, 1 wherein said step of emptying a pressure vessel includes flowing the contents of said pressure vessel from the bottom of the pressure vessel interiorly of said pressure vessel substantially along the entire length of said pressure vessel.

5. A method according to any of claims 1 to 3, wherein said step of emptying the pressure vessel from the bottom thereof includes a step of flowing the dry, bulk, particulate material outwardly from the bottom of said pressure vessel and thereafter exteriorly of said pressure vessel.

6. A method according to any preceding claim, 1 wherein said transferring of material from a pressure vessel to a storage container includes throttling a portion of the air into a different part of said pressure vessel for aerating the dry, bulk, particulate material in said pressure vessel.

7. A method according to any preceding claim, wherein the drawing the particulate material into said pressure vessel includes drawing air through a cyclone separator and said step of transferring material from a pressure vessel includes forcing any particulate material in said cyclone separator back into said pressure vessel and thereafter into said silo.

8. A method according to any preceding claim, 1 including the step of lowering said first and second pressure vessels into a hold of a ship.

9. A method according to any preceding claim, including the step of positioning the nozzle adjacent said pressure vessels to reduce the length of a suction path from said nozzle to said pressure vessels.

like through a nozzle and a suction path into first and second pressure vessels and for thereafter transferring the material from each of said pressure vessels into a storage container or silo comprising a vacuum means and a source of compressed air, said vacuum means being for inducing a suction through said pressure vessels in alternating sequence and through said suction path to said nozzle and said compressor being for pressurizing each of said pressure vessels in alternating sequence, a suction being created in one of said pressure vessels while the other said pressure vessel is being pressurized, and a bottom inlet port for each pressure vessel for filling each pressure vessel from the bottom.

11. A system according to claim 10, wherein said bottom inlet port also serves as an outlet port for transferring said material to said storage container.

12. A system according to claim 10 wherein said compressed air also aerates said material while transferring said material to said storage container.

13. A system according to claim 10, wherein said nozzle is positioned adjacent said pressure vessels for reducing the length of said suction path from said nozzle to said pressure vessels.

14. A system according to claim 10, wherein said pressure vessels are closely adjacent said nozzle so that said pressure vessels and nozzle may be lowered into a hold of a ship.

15. A method for unloading dry, bulk, particulate material from a ship, barge or the like, substantially as hereinbefore described with reference to and as shown in Fig. 1 or Fig. 2 of the accompanying drawings.

16. A system for unloading dry, bulk, particulate material from a ship, barge or the like, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1982.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.